



Shenzhen Hi-Link Electronic Co., Ltd

HLK-LD6002B

Communication Protocol

3D human presence (V3.7.1)

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1. TF Frame Description

1.1 Summary

TinyFrame is used as a communication protocol in Hi-link millimeter wave radar products. Data is transmitted through the UART interface. Unless otherwise specified, the baud rate is 115200, the data word length is 8 bits, the stop bit is 1 bit, there are no parity check bits, and there is no hardware flow control.

Each frame consists of a header and a payload. Both of these parts can be protected by checksum to ensure the rejection of frames with formatting errors (such as damaged length fields) or damaged payloads.

The frame header contains the frame ID and message type. The frame ID increases with each new message. For two peers, the highest bit of the ID field is fixed at 1 and 0 to avoid conflicts.

The frame ID can be reused in the response to connect two messages together. The value of the type field will be described later.

1.2 Frame structure

The field configuration in the millimeter wave radar frame is as follows:

Format	Length (in bytes)	Format meaning
SOF	1	The starting frame, usually fixed at 0x01.
ID	2	Frame ID, MSB equivalent bit, representing the sending packet sequence (increasing from 0 to 65535)
LEN	2	Data frame length, representing the number of DATA bytes (but due to the specified total frame length limit, the DATA bit length cannot exceed 1024)
TYPE	2	Info type
HEAD_CKSUM	1	Use TF_CKSUM_XOR to calculate the header checksum (XOR all bits from SOF to TYPE first, then invert)
DATA	N	Data bits with a length of LEN
DATA_CKSUM	1	Calculate data checksum using TF_CKSUM_XOR (XOR all bytes in the DATA bit first, then invert)

1.3 Note

TF frame arrangement method

In the TF frame, the SOF bit~HEAD-CKSUM bit and DATA_CKSUM have high bytes before and low bytes after, while the DATA bit has low bytes before and high bytes after.

For example, if the DATA data type is uint32, its value is 0x12345678. If the data is transmitted in small endian format, its value is 0x78, 0x56, 0x34, and 0x21. The data of ID data type bit uint16 has a value of 0x1234, while the data transmitted in big endian mode has a value of 0x12 0x34.

The actual data range exceeds the specified data orientation

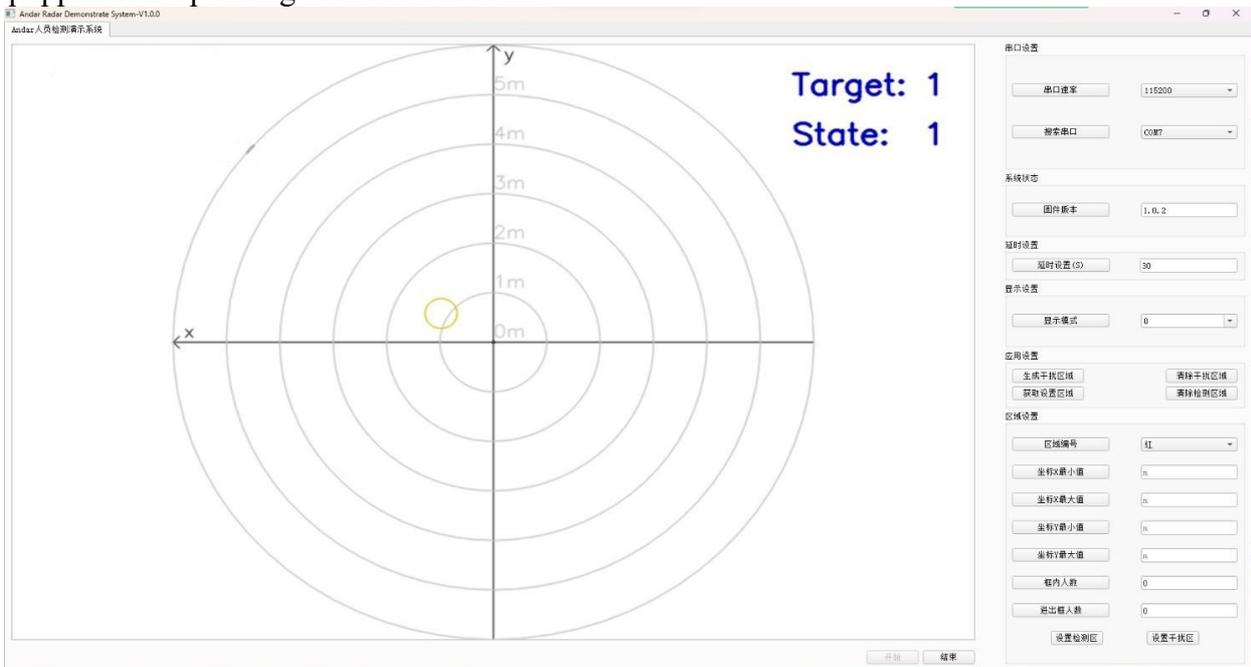
After calculation, if the HEAD_CKSUM and DATA_CKSUM bits exceed 1 byte, only the lowest 1 byte will be taken. For example, if the HEAD-CKSUM bit is 0x1232, only 0x32 will be taken in the end

Special note:

1. For all TF frames sent to the lower computer in this project, the lower computer will first reply with a message of the same TPYE type without a DATA bit, informing the upper computer that the data has been received. If there is no response, please resend the configuration message.
2. Turn on the low-power mode when unattended, and the lower level machine will enter sleep mode. Before sending the configuration message, it is necessary to pull down the RX0 pin of UART0 to wake it up. Alternatively, by sending a configuration message to wake up the lower computer and reading back to confirm if the message has been successfully configured. If there is no response, resend the configuration message.
3. After the upper computer sends data or the lower computer is awakened, the lower computer will work in normal mode and will not enter unattended low-power mode for 10 seconds. If there is no one after 10 seconds, it will enter unattended low-power mode again.

2. Application project

For different application items, all the messages related to TF frames are listed for user reference and analysis. For the message class appearing in the document and the message data bits, they are equipped corresponding to the actual items.



(There is a 3D perceptive upper computer interface)

2.1. Presence of the perceived 2D / 3D items

Message type: control instruction 0x0201

Message type is 0x0201, and only the one-way data transfer mode is supported.

The upper computer sends the data to the radar: MSG_CFG_HUMAN_DETECTION_2D					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	To setting the partial status of the radar.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	02 01	
HEAD_CKS UM	1 byte	uint8	Head checksum	F3	
DATA	4 byte	Uint32	[command]	01	
DATA_CKS UM	1 byte	uint8	Data checksum	FE	

The following is the role of command for the different values:

- 0x1: To automatically generate the interference zone.
- 0x2: To acquire the interference area and the detection area.
- 0x3: Clear the interference areas.
- 0x4: Reset the detection area.
- 0x5: Get the delay time.
- 0x6: Open the point cloud display.
- 0x7: Close the point cloud display.
- 0x8: Open the target display.
- 0x9: Close the target display.
- 0xA: set the detection sensitivity to low.
- 0xB: Set the detection sensitivity to medium.
- 0xC: Set the detection sensitivity to high.
- 0xD: Get the detection sensitivity status.
- 0xE: Set the trigger speed to slow.
- 0xF: Set the trigger speed to medium.
- 0x10: Set the trigger speed to fast.
- 0x11: Get the trigger speed status.
- 0x12: Get the Z-axis range. **Note: This agreement applies to 3D only.**
- 0x13: Set the installation as top mounted. **Note: This agreement applies to 3D only.**
- 0x14: Set the installation as side mounted. **Note: This agreement applies to 3D only.**
- 0x15: Set the installation method.
- 0x16: Turn on the low power mode when unattended.
- 0x17: Turn off the low power mode when unattended.
- 0x18: Obtain whether to turn on the low power mode when unattended.
- 0x19: Obtain the sleeping time in the low power mode when unattended.
- 0x1A: Reset unattended status

Message type: Set the coordinate position for the interference regions and detection regions 0x0202

Message type is 0x0202 and only supports one-way data transfer mode.

The upper computer sends the data to the radar: MSG_CFG_HUMAN_DETECTION_2D_AREA					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Set up the interference area and the detection area.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	00 14	
TYPE	2 byte	uint16	frame type	02 02	
HEAD_CKS UM	1 byte	uint8	Head checksum	/	
DATA	4 byte	int32	[area_id]	/	
DATA	4 byte	float	[x_min]	/	
DATA	4 byte	float	[x_max]	/	
DATA	4 byte	float	[y_min]	/	
DATA	4 byte	float	[y_max]	/	
DATA	4 byte	float	[z_min]	/	
DATA	4 byte	float	[z_max]	/	
DATA_CKS UM	1 byte	uint8	Data checksum	/	

The following is the role of the DATA data as different values:

- [Area_id]: The ID of the set area, the data type int32, 0 to 3 for the interference region, and 4 to 7 for the detection area.
- [x_min]: Set the minimum value of region x coordinates, data type float, unit: m (m).
- [x_max]: Set the maximum value of region x coordinate, data type float, unit: meters (m).
- [y_min]: Set the minimum value of the area y coordinate, data type float, unit: m (m).
- [y_max]: Set the maximum value of the area y coordinate, data type float, unit: m (m).
- [z_min]: Set the minimum value of the area z coordinate, data type float, unit: m (m).
- [z_max]: Set the maximum value of the area z coordinate, data type float, unit: m (m).
- **Note: There are 4 interference areas and 4 detection areas, ID0 to ID3 is the interference area, ID4 to ID7 is the detection area, and only one area can be set at a time.**

Note: When this protocol is used for 2D existence, please set z_min to -6m and z_max to 6m.

Message Type: Set the hold-delay time 0x0203

Message type is 0x0203, and only the one-way data transfer mode is supported.

The upper computer sends the data to the radar: MSG_CFG_HUMAN_DETECTION_2D_PWM_DELAY					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Used to set the hold-delay time.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	02 03	
HEAD_CKS UM	1 byte	uint8	Head checksum	/	
DATA	4 byte	uint 32	[pwm_delay]	1E	
DATA_CKS UM	1 byte	uint8	Data checksum	FE	

The following is the role of the DATA for the different values:

- [Pwm _ delay]: Set the delay time, data type uint 32, unit: seconds (S).
- **Note: The default is 30S.**

Message Type: Set the Z-axis range of 0x0204

Message type is 0x0204, and only the one-way data transfer mode is supported.

The upper position computer sends the data to the radar: MSG_CFG_HUMAN_DETECTION_3D_Z					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	For setting the Z-axis range.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	02 04	
HEAD_CHECKSUM	1 byte	uint8	Head checksum	/	
DATA	4 byte	float	[z_min]	/	
DATA	4 byte	float	[z_max]	/	
DATA_CHECKSUM	1 byte	uint8	Data checksum	FE	

The following is the role of the DATA for the different values:

- [z_min]: Set the minimum value of the area z coordinate, data type float, unit: m (m).
- [z_max]: Set the maximum value of the area z coordinate, data type float, unit: m (m).
- **Note: This agreement applies to 3D only.**

Message Type: Set low power mode sleep time when unattended 0x0205

Message type is 0x0205, and only supports one-way data transfer mode.

The upper position computer sends the data to the radar: MSG_CFG_HUMAN_DETECTION_3D_LOW_POWER_MODE_TIME					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	For setting the Z-axis range.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	02 05	
HEAD_CHECKSUM	1 byte	uint8	Head checksum	/	
DATA	4 byte	uint32	[waiting Period]	01 F4	
DATA_CHECKSUM	1 byte	uint8	Data checksum	FE	

The following is the function of DATA for different values

- [waiting Period]:Set the sleep time for low-power mode when no one is present, data type uint32, unit: milliseconds (ms).
- **Note: The default is 500ms.**

Message Type: Reporting Person location 0x0A04 / 0x0A08

Message type is 0x0A04, and only supports one-way data transfer mode.0x0A04 is the target data and 0x0A08 is the point cloud data.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_3D_TGT_RES					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	For the reporting of the personnel location.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	/	
TYPE	2 byte	uint16	frame type	0A 04	
HEAD_CKSUM	1 byte	uint8	Head checksum	/	
DATA	4 byte	uint 32	[target_num]	/	
DATA	4 byte	float	[x]	/	
DATA	4 byte	float	[y]	/	
DATA	4 byte	float	[z]	/	
DATA	4 byte	int32	[dop_idx]	/	
DATA	4 byte	Int32	[cluster_id]	/	
...	
DATA_CKSUM	1 byte	uint8	Data checksum	/	

The following is the corresponding meaning of each DATA-bit:

- [target_num]: Number of targets.
- [x]: x coordinates, data type float, unit: m.
- [y]: y coordinate, data type float, unit: m.
- [z]: z coordinate, data type float, unit: m.
- [Dop_idx]: datatype int 32, speed dop_idx.
- [cluster_id]: Data type int 32, cluster target ID.

Note: When there are N targets, there are also N targets for x, y,z, dop_idx, and cluster_id.

Note: In 2D, the Z-axis output of this protocol is 0

Message type:Report 3D point cloud detection project test result 0x0A08

Message type is 0x0A08, only supports one-way data transmission mode (automatic upload after enabling User log).

The radar sends the data to the upper computer: MSG_IND_3D_CLOUD_RES					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Used to report 3D point cloud detection results. The message type 0x0A08 is point cloud information
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	/	
TYPE	2 byte	uint16	frame type	0A 08	
HEAD_CKSUM	1 byte	uint8	Head checksum	/	
DATA	4 byte	uint 32	[target_num]	/	
DATA	4 byte	float	[cluster_index]	/	
DATA	4 byte	float	[x_point]	/	
DATA	4 byte	float	[y_point]	/	
DATA	4 byte	float	[z_point]	/	
DATA	4 byte	float	[speed]	/	
DATA_CKSUM	1 byte	uint8	Data checksum	/	

The following is the corresponding meaning of each DATA:

- [target_num]: Number of targets.
- [cluster_index]: cluster object ID
- [x_point]: x-coordinate, unit: m
- [y_point]: y-coordinate, unit: m
- [z_point]: z-coordinate, unit: m
- [speed]: speed, unit: m/s

When there are N point clouds, there are also N point of x, y, z, and dop_idx, and the cluster_id distance is similar. The point cloud ID is the same. Example:

```

01 41 A1 00 68 0A 08 74 05 00 00 00 00 00 00 00 62 F6 C2 BD 38 24 F7 3E E6 A8 41 3E 39 63 18 BC 00
起始帧 帧ID 数据帧长度 帧类型 头校验和 点云个数 点云ID x0坐标 y0坐标 z0坐标 速度V0
00 00 00 D5 94 A5 BD 14 9E 18 3F 69 2C FA 3C 39 63 18 BC 00 00 00 00 73 5C 2F BE 3C 4F F8 3E EE EE
点云ID x1坐标 y1坐标 z1坐标 速度V1 点云ID x2坐标 y2坐标 z2坐标
E1 3E 39 63 18 BC 00 00 00 00 BF 56 CA BD F8 E4 EE 3E 39 CC 65 3E 39 63 18 3C 00 00 00 00 48 0B A3
速度V2 点云ID x3坐标 y3坐标 z3坐标 速度V3 点云ID x4坐标
BD 37 92 18 3F E0 2F 16 3D 39 63 18 3C 6F
y4坐标 z4坐标 速度V4 数据校验和

```

Message type: Report if anyone is in the area 0x0A0A

Message type is 0x0A0A, and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_3D_RES					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Report if anyone is in the area.
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	0A 0A	
HEAD_CKS UM	1 byte	uint8	Head checksum	F3	
DATA	4 byte	uint 32	[detection_state_area0]	01	
DATA	4 byte	uint 32	[detection_state_area1]	01	
DATA	4 byte	uint 32	[detection_state_area2]	00	
DATA	4 byte	uint 32	[detection_state_area3]	01	
DATA_CKS UM	1 byte	uint8	Data checksum	FE	

The following is the corresponding meaning of each DATA-bit:

- Report whether there is anyone in the 4 testing areas, 1 is someone, and 0 is nobody.

Message type: 0x0A0B / 0x0A0C

Message type 0x0A0B is the interference area, 0x0A0C is the detection area, and only one-way data transmission mode is supported.

The radar sends the data to the upper computer: MSG_IND_HUMAN_(NOISE) DETECTION_2D_NOISE_AREA_RES					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	When the upper computer sends commands with data type 0x0201 and data 0x02. Lower opportunity to send two TF frames, 0x0A0B and 0x0A0C. Where 0x0A0B is the message of the interference region and 0x0A0C is the detection region
ID	2 byte	uint16	frame ID	00 00	
LEN	2 byte	uint16	Data frame length	/	
TYPE	2 byte	uint16	frame type	0A 0B /0A 0C	
HEAD_CKS UM	1 byte	uint8	Head check and	/	
DATA	4 byte	uint 32	[x_min]	/	
DATA	4 byte	float	[x_max]	/	
DATA	4 byte	float	[y_min]	/	
DATA	4 byte	float	[y_max]	/	
DATA	4 byte	float	[z_min]	/	
DATA	4 byte	float	[z_max]	/	
...	
DATA_CKS UM	1 byte	uint8	Data verification and	FE	

The following is the corresponding meaning of each DATA-bit:

- [x_min]: Set the minimum value of region x coordinates, data type float, unit meters (m).
- [x_max]: Set the maximum value of region x coordinate, data type float, unit meters (m).
- [y_min]: Set the minimum value of the area y coordinate, data type float, unit meters (m).
- [y_max]: Set the maximum value of the area y coordinate, data type float, unit meters (m).
- [z_min]: Set the minimum value of the area z coordinate, data type float, unit meters (m).

- [z_max]: Set the maximum value of the area z coordinate, data type float, unit meters (m).

Note: This message reports the location of the interference area, there are 4 interference areas and 4 detection areas, 0x0A0B reports the coordinates of the 4 interference areas, and 0x0A0C reports the coordinates of the 4 detection areas.

Note: This protocol is only used for 2D, with z_min set to -6m by default and z_max set to 6m by default.

Message type: reporting delay time 0x0A0D

The message type is 0x0A0D and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_2D_PWM_DELAY					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Get the hold-delay time.
ID	2 byte	uint16	frame ID	00 01	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	0A 0D	
HEAD_CKSUM	1 byte	uint8	Head checksum	F C	
DATA	4 byte	uint8	[pwmDelayTimer]	05	
DATA_CKSUM	1 byte	uint8	Data checksum	F A	

The following is the corresponding meaning of each DATA-bit:

- Keep the delay time alive.

Message type: reported the detection sensitivity status of 0x0A0E

The message type is 0x0A0E, and only the one-way data transfer mode is supported.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_2D_DETECT_SENSITIVITY					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Obtain the detection sensitivity status.
ID	2 byte	uint16	frame ID	00 01	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	0A 0E	
HEAD_CKSUM	1 byte	uint8	Head checksum	F F	
DATA	1 byte	uint8	[detectSensitivity]	01	
DATA_CKSUM	1 byte	uint8	Data checksum	FE	

The following is the corresponding meaning of each DATA-bit:

- Report test sensitivity, 0: low, 1: medium, 2: high.

Message type: reported trigger speed status 0x0A0F

Message type is 0x0A0F and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_2D_DETECT_TRIGGER					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Get the trigger speed status.
ID	2 byte	uint16	frame ID	00 01	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	0A 0F	
HEAD_CKSUM	1 byte	uint8	Head checksum	FB	
DATA	1 byte	uint8	[detectTrigger]	02	
DATA_CKSUM	1 byte	uint8	Data checksum	FD	

The following is the corresponding meaning of each DATA-bit:

- Report the trigger speed, 0: slow, 1: medium, 2: fast.

Message type: reported Z axis range 0x0A10

Message type is 0x0A10, and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_2D_DETECT_TRIGGER					
form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Gets the Z-axis setting range.
ID	2 byte	uint16	frame ID	00 01	
LEN	2 byte	uint16	Data frame length	00 04	
TYPE	2 byte	uint16	frame type	0A 10	
HEAD_CKSUM	1 byte	uint8	Head checksum	FB	
DATA	4 byte	float	[z_min]	/	
DATA	4 byte	float	[z_max]	/	
DATA_CKSUM	1 byte	uint8	Data checksum	FD	

The following is the corresponding meaning of each DATA-bit:

- [z_min]: Set the minimum value of the area z coordinate, data type float, unit:meters (m).
- [z_max]: Set the maximum value of the area z coordinate, data type float, unit: meters (m).
- **Note: This agreement applies to 3D only.**

Message type: reported installation method 0x0A11

Message type is 0x0A11, and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_3D_INSTALL_SITE					
Form	Byte number	fundamental type	frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Obtain installation method
ID	2 byte	uint16	Frame ID	02 2E	
LEN	2 byte	uint16	Data frame length	00 01	
TYPE	2 byte	uint16	Frame type	0A 11	
HEAD_CKSUM	1 byte	uint8	Head checksum	C8	
DATA	1 byte	uint8	[installSite]	/	
DATA_CKSUM	1 byte	uint8	Data checksum	FD	

The following is the corresponding meaning of each DATA-bit:

- Report installation methods, 0: top mounted, 1: side mounted.

Message type: reported low power mode when unattended 0x0A12

Message type is 0x0A12, and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_3D_LOW_POWER_MODE					
Form	Byte number	Fundamental type	Frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Obtain low power mode when unattended
ID	2 byte	uint16	Frame ID	02 2E	
LEN	2 byte	uint16	Data frame length	00 01	
TYPE	2 byte	uint16	Frame type	0A 12	
HEAD_CKSUM	1 byte	uint8	Head checksum	/	
DATA	1 byte	uint32	[lowPowerMode]	/	
DATA_CKSUM	1 byte	uint8	Data checksum	FD	

The following is the corresponding meaning of each DATA-bit:

- 0: turn off the low power mode when unattended
- 1: turn on the low power mode when unattended

Message type: reported low power mode sleep time when unattended 0x0A13

Message type is 0x0A13, and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_3D_LOW_POWER_MODE					
Form	Byte number	Fundamental type	Frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	Obtain low power mode sleep time when unattended
ID	2 byte	uint16	Frame ID	02 2E	
LEN	2 byte	uint16	Data frame length	00 01	
TYPE	2 byte	uint16	Frame type	0A 13	
HEAD_CKSUM	1 byte	uint8	Head checksum	/	
DATA	1 byte	uint32	[waitingPeriod]	/	
DATA_CKSUM	1 byte	uint8	Data checksum	FD	

The following is the corresponding meaning of each DATA-bit:

- low power mode sleep time when unattended

Message type: reported work mode 0x0A14

Message type is 0x0A14, and only supports one-way data transfer mode.

The radar sends the data to the upper computer: MSG_IND_HUMAN_DETECTION_3D_MODE					
Form	Byte number	Fundamental type	Frame structure	Example frames	The frame meaning
SOF	1 byte	uint8	Start frame	01	report work mode
ID	2 byte	uint16	Frame ID	02 2E	
LEN	2 byte	uint16	Data frame length	00 01	
TYPE	2 byte	uint16	Frame type	0A 14	
HEAD_CKSUM	1 byte	uint8	Head checksum	/	
DATA	1 byte	uint8	[detectStateMessenger]	/	
DATA_CKSUM	1 byte	uint8	Data checksum	FD	

The following is the corresponding meaning of each DATA-bit:

- 0: The mode is unattended low-power mode.
- 1: The mode is normal mode.

Note: This message will be sent when switching between unmanned low-power mode and normal mode.

3. Programming interface

3.1. Encode the TF message

```
void tinyFrameTx(TF_TYPE type, uint8 *data, TF_LEN len);
```

Where type is the sending data type, the uint16 type, for example, the personnel detection data result report, the data type is 0x0A10. See 4.2.1.6 for details

Uint8 * Data is the address that sends the data.

Len is the length of the sent data, the uint16 type.

3.2. Decode the TF message

```
TinyFrameRx tinyFrameRx(void);
```

After successfully receiving the message, the received data is returned to a variable of type TinyFrameRx.

A. The following is the method for retrieving DATA bit data:

As follows: When the serial port receives hexadecimal data, uint32 is converted to float. For example, [x_point] bits are 0x66, 0x66, 0xA2, and 0x41, which are first concatenated into uint32 bits for shaping. Due to the small end order of the TF frame Data bit, the value is 0x41A26666. Then, float type strong conversion is performed, and the final result is 20.3.

```
1. int main(void)
2. {
3.     unsigned int param = 0x41A26666;
4.     float res = *(float *)&param;
5.
6.     printf("data: %f\n", res);
7.     return 0;
8. }
```

B. Following is the analysis of each CKSUM:

HEAD-CKSUM: TF frame header checksum [from the first byte to the previous byte of the HEAD-CKSUM bit]

DATA_CKSUM: TF data checksum [the first byte of DATA to the previous byte of DATA_CKSUM bit]

The method C code for calculating CKSUM is shown below

```
1. unsigned char getCksum(unsigned char *data, unsigned char len)
2. {
3.     unsigned char ret = 0;
4.
5.     for (int i = 0; i < len; i++)
6.         ret = ret ^ data[i];
7.
8.     ret = ~ret;
9.
10.    return ret;
11. }
12.
```

3.3. Example code

If you want to analyze the demo of TF frame data (including C message in Linux environment and Python language demo) in Keil μ Vision5 environment, you can directly communicate with the sales.



Shenzhen Hi-Link Electronic Co., Ltd

Address: 17F,Building E, Xinghe WORLD, Minzhi Street, Long Hua district,
Shenzhen 51813

Email: sales@hlktech.com

Website: www.hlktech.net

